

# EE 669 Course Syllabus

**Term:** Fall 2021

**Course Title:** Multimedia Data Compression

**Lecture:** 8:00 - 9:20 am, GFS 222, Monday and Wednesday

**Discussion:** 4:00-4:50pm, GFS 223, Thursday

**Instructor:**

Prof. C.-C. Jay Kuo

Room 440, Electrical Engineering Building (EEB)

3740 McClintock Ave., Los Angeles, CA 90089-2564

E-mail: [cckuo@sipi.usc.edu](mailto:cckuo@sipi.usc.edu)

Phone: (213) 740-4651

**Website:** <http://blackboard.usc.edu>

1. Course materials, project assignment and announcements are available on the website.
2. Homework submissions and returns are handled electrically (no paper copies).
3. FAQ regarding homework will be posted by TA on the discussion board.

**Instructor Office Hours:**

Monday and Wednesday: 9:30-10:30 am

Zoom Link:

<https://usc.zoom.us/j/7918142126?pwd=WUgxRHVXU05jaTNGU2dKMW11eU9RZz09>

Meeting ID: 791 814 2126

Passcode: 669321

(For homework-related issues, please consult with the TA or grader first.)

**Teaching Assistant and Office Hours:**

Yijing Yang ([yijingya@usc.edu](mailto:yijingya@usc.edu)): Tuesday 9:30-10:30 am, Friday 2:00-4:00 pm

Zoom Link:

<https://usc.zoom.us/j/96518900274?pwd=Z3BoRzhuQzIwMjVtWXNOL05BUVpMdz09>

Meeting ID: 965 1890 0274

Passcode: 088845

**Grader:**

Yifan Wang ([wang608@usc.edu](mailto:wang608@usc.edu))

Office Hours will be announced after each graded homework.

**Textbook:**

None. About 90% of the course material is prepared in Power-point slides. The PDF files corresponding to any other topics will be available on the DEN course website.

**Prerequisites:**

Familiarity with C/C++ programming and MATLAB.

Students are expected to comprehend existing C/C++ programs and modify the code for various goals. The students may also be required to write small programs from the scratch.

Provided sample code comes with makefiles for compilation under Unix environment.

Either familiarity with basic unix commands or the ability to convert the codes to a Window's project is required.

**Homework Assignment:**

All homework assignments will be due on Sunday midnight (11:59pm) - no late homework will be accepted.

Assignment No. 1: Huffman and LZW Coders

Issued on August 23 (Monday), Due on September 12 (Sunday)

Assignment No. 2: QM Coder

Issued on September 13 (Monday), Due on September 26 (Sunday)

Assignment No. 3: Scalar and Vector Quantization

Issued on September 27 (Monday), Due on October 10 (Sunday)

Assignment No. 4: JPEG Image Compression

Issued on October 11 (Monday), Due on October 24 (Sunday)

Assignment No. 5: H.264/AVC

Issued on October 25 (Monday), Due on November 14 (Sunday)

Assignment No. 6 (or Term Project): Image/Video Quality Assessment (SSIM and VMAF)

Issued on November 15 (Monday), Due on December 5 (Sunday)

**Mid-term Exams:** Open-book exam.

Mid-term Exam: November 3 (Wednesday) 8:00-9:30am

**Oral Test:**

An oral test will be held at the end of the semester. The students will be asked about their implementation of the six projects.

**Grading Policy:**

1. Midterm Exam: 16%
2. Homework Assignments: 84% (14 points each)
  - a. Quality of written report (6 points each)
  - b. Quality of experimental results (6 points each)
  - c. Quality of codes plus semester-end oral exam (2 points each)

**Tentative Schedule:**

**Week 1:** Overview, Information Theory, Shannon-Fano codes, Huffman codes

**Week 2:** Adaptive Huffman coding, Lempel-Ziv codes

**Week 3:** QM codes and context-based QM codes

**Week 4:** Scalar and vector quantizers

**Week 5:** JPEG, MPEG

**Week 6:** H.264/AVC

**Week 7:** Rate control and motion estimation

**Week 8:** Audio/speech coding

**Week 9:** Image/video quality assessment

**Week 10:** Perceptual image/video coding

**Week 11:** Emerging data compression topics

**Week 12:** Emerging data compression topics

### **General References:**

1. Anil K. Jain: Fundamentals of Digital Image Processing, Prentice Hall, 1989.
2. Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing, Addison-Wesley, 1992
3. Gilbert Held: Data and Image Compression, John Wiley & Sons Ltd., 1996
4. Majid Rabbani (Edited): Selected Papers on Image Coding and Compression, SPIE Milestone Series, 1992

### **References on Lossless Compression**

5. Robert M. Gray: Source Coding Theory, Kluwer Academic Publishers, 1991
6. Tomas M. Cover and Joy A. Thomas: Elements of Information Theory, Wiley-Interscience Publication, John Wiley & Sons, Inc. 1991
7. Mark Nelson and Jean-Loup Gailly: The Data Compression Book, 2<sup>nd</sup> Edition, M&T Books, 1996
8. Khalid Sayood: Introduction to Data Compression, Morgan Kaufmann Publishers Inc., 1996
9. Timothy C. Bell, John G. Cleary and Ian H. Witten: Text Compression, Prentice Hall PTR, Englewood Cliffs, 1990

### **Reference on Audio and Speech Compression**

10. Dai Tracy Yang, Chris Kyriakakis and C.-C. Jay Kuo: High Fidelity Multichannel Audio Coding, Hindawi Publishing Corporation, 2004.

### **References on Scalar and Vector Quantization**

11. Anil K. Jain: Fundamentals of Digital Image Processing, Prentice Hall, 1989.
12. Allen Gersho and Robert M. Gray: Vector Quantization and Signal Compression, Kluwer Academic Publishers, 1991

### **References on Still Image Compression**

13. William B. Pennebaker and Joan L. Mitchell: *JPEG: Still Image Data Compression Standard*, Van Nostrand Reinhold, 1993.
14. K. R. Rao and P. Yip: Discrete Cosine Transforms: Algorithms, Advantages, Applications, Academic Press, 1990
15. John W. Woods: Subband Image Coding, Kluwer Academic
16. Paul M. Farrelle: Recursive Block Coding for Image Data Compression, Springer Verlag, 1990
17. Michael F. Barnsley and Lyman P. Hurd: Fractal Image Compression, Jones and Bartlett, 1993

### **References on Video Compression**

18. A. Murat Tekalp: Digital Video Processing, Prentice Hall PTR, Upper Saddle River, 1995
19. K. R. Rao and J. J. Hwang "Techniques and Standards for Image, Video and Audio Coding", Prentice Hall PTR, Upper Saddle River, 1996
20. Joan L. Mitchell, William B. Pennebaker, Chad E. Fogg and Didier J. LeGall: MPEG Video Compression Standard, Chapman, 1997.

### **References on Wired and Wireless Video Delivery**

21. Yao Wang, Jörn Ostermann and Ya-Qin Zhang: *Video Processing and Communications*, Prentice Hall, 2002.

Note: In addition to the above reference books, some journal papers will be provided as reference reading material.

## Statement on Academic Conduct and Support Systems

### **Academic Conduct:**

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

### **Support Systems:**

Counseling and Mental Health - (213) 740-9355 – 24/7 on call  
[studenthealth.usc.edu/counseling/](https://studenthealth.usc.edu/counseling/)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 - 24/7 on call

<http://www.suicidepreventionlifeline.org>

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours - 24/7 on call

<https://studenthealth.usc.edu/sexual-assault/>

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086/Title IX - (213) 821-8298

<https://equity.usc.edu/>, <http://titleix.usc.edu/>

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

[https://usc-advocate.symplicity.com/care\\_report/](https://usc-advocate.symplicity.com/care_report/)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

<http://dsp.usc.edu>

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

<https://uscsa.usc.edu/>

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

<https://diversity.usc.edu/>

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

<http://dps.usc.edu/>, <http://emergency.usc.edu>

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

<http://dps.usc.edu>

Non-emergency assistance or information.

Updated January 16, 2019